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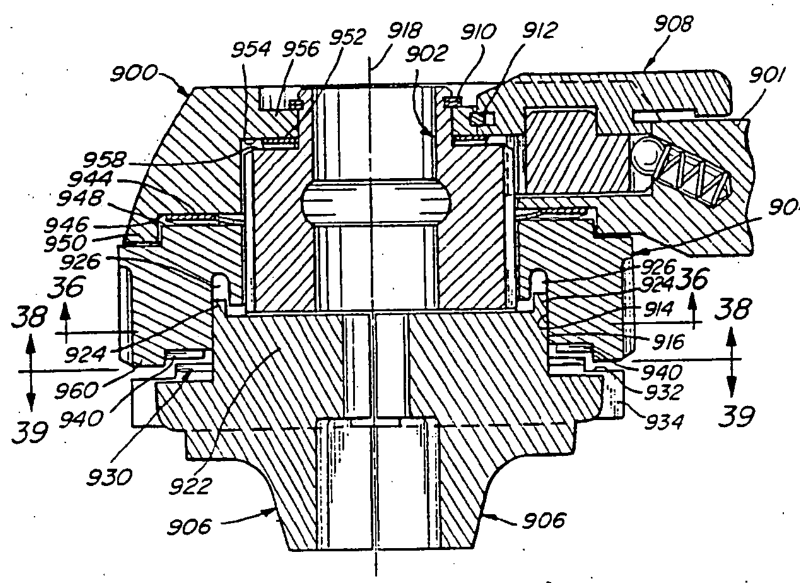

(57) Abstract

An adjustable ratchet wrench has a housing (900) carried by a handle (901). The housing has a generally cylindrical chamber which carries a control member (902) that in turn supports the jaws (906). The control member (902) is connected to the handle by a ratchet assembly (908) whose setting determines the direction in which the tool may be used to turn a workpiece. The housing (900) also carries an adjusting disk that engages the jaws (906) and opens and closes them depending upon the direction in which it is rotated. A locking mechanism (930), (940) is provided to prevent the jaws (906) from opening after they have been adjusted to grip a particular workpiece in response to reactive forces on the jaws. The wrench may have a power handle (1022) to drive the workpiece.

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TITLE OF THE INVENTION

ADJUSTABLE WRENCH

RELATED APPLICATIONS

This application is a continuation-in-part of prior co-pending application Serial No. 07/638,828. filed January 8, 1991 which in turn is a continuation-in-part of prior co-pending applications Serial No. 07/387,220 filed July 28, 1989, now abandoned, Serial No. 07/392,206 filed August 10, 1989, now Patent No. 5,067,376 dated November 26, 1991 and Serial No. 07/567,290 filed August 14, 1990, now Patent No. 5,090,273. Co-applicant Gregory Fossella is the sole inventor in all of the above-identified patents and applications. The disclosures of these applications is incorporated herein by reference.

INTRODUCTION

This invention relates to adjustable wrench heads. The invention may be embodied in either a manually operated wrench or a wrench having a power handle which allows it to be operated both manually and automatically. The wrench head also has application in modular tools with square drives, ratchet handles etc.

The present invention is an improvement over the adjustable wrenches shown in the earlier applications identified above. The wrenches in the earlier applications, supra, are all capable of use with a large range of sizes of nuts and bolts. In the previous application Serial No. 07/387,220, filed July 28, 1989, an adjustable wrench is disclosed that will accommodate both standard and metric sizes within the range of 5/16th to 1 inch in diameter. A similar range of sizes is accommodated by the extension wrench shown in the application Serial No. 07/392,206, filed August 10, 1989. Most conventional ratchet and extension wrenches in use today require a large number of interchangeable heads to accommodate workpieces of different diameters. For example, approximately 41 different heads are required to accommodate both standard and metric sizes within the range of from 5/16th to 1 inch in diameter. An additional equal number of heads may be required if deep bolt clearance is necessary to perform the work.

The principle object of the present invention is to provide an adjustable wrench head capable of accommodating a wide range of sizes of nuts and bolts.

Another important object of the present invention is to provide an adjustable wrench head which is suitable for use in manual and power tools, and also is suitable for use both as the working head of an extension wrench as well as a ratchet

wrench.

Another important object of the present invention is to provide an adjustable wrench head which is relatively small, has relatively few parts, and is stronger and less dependent on tight tolerances than the wrench heads of the prior applications supra.

Yet another important object of the present invention is to provide an adjustable wrench head in which the jaws of the wrench may be adjusted to a particular bolt size and locked in position.

To accomplish these and other objects, the adjustable wrench head of the present invention includes a generally cylindrical housing open at the bottom and at the top, and includes at least two gripping jaws which extend out the open bottom. A control disk is disposed inside the housing and engages the upper ends of the jaws so as to confine the motion of the jaws to a radial direction with respect to the control disk. The control disk in turn may be selectively locked to the housing with a ratchet assembly which prohibits relative rotation of the control disk with respect to the housing in the selected direction. An adjusting disk is mounted for rotation relative to the housing. The adjusting disk extends out of the housing and it has a gripping ring which facilitates its rotation by the tool user. In the preferred embodiment of this invention, the control disk or member has a flange that supports the adjusting disk from beneath. The

adjusting disk surrounds the jaws, and the jaws and adjusting ring have mating cam surfaces which cause the jaws to move radially toward or away from the housing axis (to close or open the jaws) when the adjusting disk is rotated. One or more additional cam surfaces is provided on the adjusting disk and the jaws to stabilize them in the housing and prevent the jaws from canting when pressure is applied to their gripping faces by the workpiece engaged by them.

A locking device is provided for engagement with either the adjusting disk or the control disk to lock the jaws of the wrench in a desired position once they contact the workpiece. In the locked state, the jaws will not open in response to reactive forces applied to the jaws by the workpiece as it is turned by the tool.

In one embodiment of the present invention, the housing carries a radially extending handle by which the tool may be turned to rotate the work engaged by the jaws.

In accordance with other embodiments of this invention, the housing is provided with a handle which not only may function to turn the tool manually, but also contains a power pack for automatically driving the tool. In the preferred embodiment the control member is turned stepwise by a motor.

In the preferred embodiment of the invention, the jaws of the wrench are locked by a wave washer

disposed between the housing and the control disk to bias the control disk vertically downward so that teeth on the bottom of the control disk engage a top gear on the adjusting disk.

These and other objects and features of the present invention will be better understood and appreciated from the following detailed description of several embodiments thereof, selected for purposes of illustration and shown in the accompanying drawings.

BRIEF FIGURE DESCRIPTION

FIG. 1 is a vertical cross-sectional through the head of the preferred embodiment of manually operated adjustable ratchet wrench, constructed in accordance with this invention, with the jaw locking device shown in the open position enabling the jaws to be opened by rotation of the adjusting disk;

FIG. 2 is a view similar to FIG. 1 but showing the locking device in the locked position so as to prevent opening of the jaws;

FIG. 3 is a vertical cross-sectional view of the head of the adjustable ratchet wrench shown in FIGS. 1 and 2 taken along section line 35-35 in FIG. 2;

FIG. 4 is a horizontal cross-sectional view of the head of the tool taken along section line 36-36 in FIG. 1;

FIG. 5 is a side elevation view of the head of the adjustable wrench shown in FIGS. 1-4 with a portion of the adjusting ring and control member broken away so as to expose the gears that form part of the locking assembly for the jaws;

FIG. 6 is a horizontal cross-sectional view of the head of the adjustable wrench, taken along section line 38-38 in FIG. 1;

FIG. 7 is horizontal cross-sectional view of the head of the adjustable ratchet wrench shown in FIGS. 1-6, taken along the section line 39-39 in FIG. 1;

FIG. 8 is a side elevation view of the head of an adjustable ratchet wrench similar to that of FIG. 5 but showing a modification of the jaw locking device with its parts in the unlocked position;

FIG. 9 is a side elevation view of the embodiment shown in FIG. 8 but with the jaw locking assembly in the locked position;

FIGS. 10 and 11 are horizontal cross-sectional views of the head of the adjustable ratchet wrench shown in FIGS. 8 and 9, taken along the section lines 42-42 and 43-43 in FIG. 8, respectively;

FIG. 12 is a diagrammatic view of yet another embodiment of this invention which enables the ratchet wrench to be either manually or automatically powered;

FIG. 13 is vertical cross-sectional view of the tool taken along the section line 50-50 in FIG. 12;

FIG. 14 is an enlarged fragmentary

cross-sectional view of the head end of the tool shown in FIGS. 12 and 13.

FIG. 15 is a perspective view of the eccentric pin and slide connection for driving the head of the tool;

FIG. 16 is an elevation view of the eccentric pin and slide showing in broken lines the circular path of the eccentric pin and the translational oscillating motion of the slide;

FIGS. 17-20 are horizontal cross-sectional views taken along the section lines 52-52, 53-53, 54-54 and 55-55 in FIG. 14; and

FIGS. 21-24 are a series of a horizontal cross-sectional views showing a sequence of positions of the power drive assembly of the tool shown in FIGS. 12-20.

DETAILED DESCRIPTION

Preferred Embodiment of Manual Adjustable Ratchet Wrench

In FIGS. 1-7 the preferred embodiment of the manually operated, two jaw, adjustable ratchet wrench is shown. The tool of this embodiment a includes a head having a housing 900 with a handle 901, control member 902, adjusting disk 904, jaws 906 and ratchet assembly 908 for selecting the direction of drive of the handle on the head. In this embodiment retaining rings 910 and 912

respectively, retain the control member 902 and ratchet assembly 908 in the housing 900. The adjusting disk 904 has inwardly facing cam surfaces 914 that bear against the mating outside surfaces 916 of the jaws 906 to push them toward the tool axis 918 when the disk 904 is turned clockwise as is apparent from an inspection of FIG. 4. The jaws 906 are retained in the assembly and confined to radial motion with respect to the control member 902 by means of the T-shaped guide slots 920 in the bottom of the control member 902 and the cooperating T-shaped ribs 922 on the tops of the jaws, as shown in FIG. 3. The jaws are opened by counterclockwise rotation of the adjusting disk 904 by virtue of the registration of the cam follows 924 carried by the jaws 906 with the cam tracks 926 in the adjusting disk, which parallel the cam surfaces 914 and 916 (see FIG. 4).

The locking mechanism for preventing unintentional spreading of the jaws includes a circular gear 930 provided in the upper surface 932 of the lower circular flange 934 of the control member 902 and a mating pair of arcuate gear segments 940 on the bottom of the control disk 904 (see FIGS. 1 and 5). As shown in FIG. 5, the teeth of the circular gear and gear segments are saw tooth in shape having one essentially vertical side and one inclined side defining each tooth. It is evident in FIG. 5 that when the teeth are engaged as shown, the adjusting disk 904 cannot be turned

counterclockwise (to the right) because the mating sides of the opposed teeth abutting one another are essentially vertical and, therefore, the adjusting disk 904 cannot ride over the teeth of the circular gear 930. Because counterclockwise rotation of the adjusting disk is required to open the jaws, the jaws cannot be opened unless the adjusting disk is raised so as to disengage the gear segments 940 from the circular gear 930.

In FIG. 1 a wave spring 944 is shown disposed between the upper surface 946 of the adjusting disk 904 and the lower surface 948 of housing 900. The wave spring 944 urges the adjusting disk downwardly toward the flange 934 of the control member 902 so as to cause the teeth of the arcuate gear segments to engage the teeth of the circular gear. In that position, the operator can rotate the adjusting disk 904 in a clockwise direction as the inclined surfaces of the respective gears will cause the gear segments to ride up and over the opposed teeth. The wave spring 944 is not so stiff as to prevent the operator from turning the adjusting disk with his fingers, as the spring 944 will allow the adjusting disk to move up and down the small distance required to enable the teeth of the gear segments to step over the circular gear teeth. As clearly shown in FIG. 1, a dirt barrier 950 in the form of a collar extends downwardly from the periphery of the housing 900 and closes the chamber occupied by the wave spring 944 between the surfaces 946 and 948.

A second wave spring 952 is disposed between the surface 954 of flange 956 of housing 900 and the upper surface 958 of the control member 902. Wave spring 952 urges the control member in a downward direction relative to housing 900 so as to yieldably hold the circular gear 930 carried on the lower flange 934 of the control member in a lowermost position. This assures that maximum space is provided for vertical movement of the adjusting disk 904 so that the teeth of the gear segments 940 and of the circular gear 930 can be disengaged so as to open the jaws 906 when desired.

A second dirt barrier 960 in the form of a circular collar is provided on the bottom of the adjusting disk 904 radially beyond the gear segments 940. The dirt barrier 960 prevents foreign matter from collecting between the gear segments 940 and the circular gear 930 on the control member flange 934, which could interfere with the proper operation of the locking assembly for the jaws.

In order to close the jaws 906 on the work piece, the adjusting disk 904 is turned clockwise which causes the cam surfaces on the adjusting disk to bear against the mating surfaces on the jaws and move them inwardly in a radial direction along a path defined by the T-shaped slots in the control member. The adjusting disk may be turned readily as the ramp configuration of the teeth on the gear segments and circular gear allow the control disk to rotate as it moves up and down as permitted by the

wave spring 944. After the work is performed, the jaws may be opened simply by lifting the adjusting disk 904 to disengage the teeth of the gear segments from the circular gear and particularly the mating vertical faces of the gear teeth so that the disk may be turned counterclockwise. The cam tracks 926 will cause the cam followers 924 to draw the jaws 906 apart.

Modified Jaw Locking Assembly for the Embodiment of FIGS. 1-17

The modification shown in FIGS. 8-11 has a rotatable cam ring to release the gear segments on the adjusting disk from the circular gear on the flange of the control member so as to permit the adjusting disk to be turned counterclockwise to open the jaws. Corresponding parts in this embodiment bear the same numbers followed by suffix "a" as used in the embodiment of FIGS. 1-7. In accordance with the present embodiment, to raise the adjusting disk 904a cam ring 970 is provided between the lower surface of the dirt barrier collar 960a and the flange 934a of the control member 902a. The ring 970 carries a pair of cams 972 each having a ramp 974 that faces the lower surface of the dust barrier 960a. Notches 976 similar in size and shape to the cam 972 are provided in the lower surface of the dust barrier 960a, and when the cam 972a and notches 976 are aligned with one another, the adjusting disk 904a is permitted to move to its lowermost position

under the influence of the wave spring 944 (see FIG. 1) so as to cause engagement of the gear segments 940a with the circular gear 930a. When the ring 970 is turned, however, the cam surface or ramp 974 bears against the mating surface of the notch 976 causing the adjusting disk 904a to rise to the position shown in FIG. 8 wherein the gear segments 940a and circular gear 930a are disengaged. In that position, the adjusting disk 904a is free to rotate counterclockwise so as to open the jaws 906.

To facilitate rotation of the ring 970, a pair of posts 980 are connected to the ring 970 and lie within shallow recesses 982 provided in the periphery of the adjusting disk 904a. This arrangement is clearly shown in FIG. 10. The outer surface of each post 980 extends outside the recess 982 and therefore it is readily accessible to the tool user. When the operator wishes to open the jaws, he simply moves the post 980 in a counterclockwise direction as viewed in FIG. 10, which automatically causes the adjusting disk 904a to elevate to a position so that it may rotate and open the jaws. To relock the jaws after they have been adjusted on a work piece, the operator need simply move the posts 980 in a clockwise direction so as to cause the cams 972 to register with the slots 976, which allows the adjusting disk 904a to return to the position shown in FIG. 9.

Preferred Embodiment of Power Adjustable Ratchet Wrench

The automatically powered adjustable ratchet wrench shown in FIGS. 12-24 comprises a head 1020 and handle 1022 integrally joined by a housing 1024. The housing 1024 is shown in outlined form in FIGS. 12 and 13. The housing 1024 provides the physical connection between the handle and head which enables the tool to be manually operated to turn the workpiece to be driven by the tool.

The head 1020 shown in detail in FIG. 14 includes as its major elements the housing 1024, control member 1026, adjusting disk 1028, jaws 1030 reversing pawl assembly 1032 and jaw locking assembly 1034. Several of these parts are described more fully below. The handle 22 contains as its major components a rechargeable battery 1036, On/Off assembly switch 1038, motor 1040, planetary gear reduction system 1042 and eccentric pin and gear shaft assembly 1044. The latter serves to connect the power handle to the head so as to enable the tool to be operated automatically by the motor.

The major parts of head 1020 are essentially the same as the head of the manually operated tool shown in FIGS. 33-39. In this embodiment, however, the head is rotated stepwise by the power handle.

The control member 1026, adjusting disk 1028 and jaws 1030 in this embodiment cooperate in precisely the same manner as the manual tool shown

in the embodiment of FIGS. 1 to 7. Thus, the control member 1026 has T-shaped radial slots (not shown) that received the T-shaped ribs (not shown) on the upper ends of the jaws so as to prevent rotation of the jaws relative to the control member (see FIG. 3). The cooperating T-shaped slots and ribs confine motion of the jaws relative to the control member to a radial path wherein the jaws move only toward and away from the head axis 1104. The adjusting disk 1028 has the same cam tracks and cam surfaces as present in the adjusting disk of the embodiment of FIGS. 1 to 7 so as to cause the jaws to move radially in the tracks of the control member when the control disk 1028 is rotated.

The reversing pawl assembly 1032 which controls the direction of drive is a duplication of the pawl assembly 908 in operatively connecting the control member 1026 to the handle. As shown in FIGS. 14 and 18, the pawl assembly 1032 includes reversing pawl 1050 and control lever 1052 that are coupled together by the non-circular mating post 1054 and recess 1056 in the pawl and lever, respectively. Pawl 1050 carries two sets of teeth 1058 and 1060 to selectively engage the circular gear 1051 formed on the outer surface of control member 1026. The alternate positions of the pawl are established by the ball detent 1062 and the recesses 1064 and 1066 in the pawl on the side opposite the teeth 1058 and 1060. This structure is functionally identical to the corresponding structure in the embodiment of

FIGS. 1 to 7. With the pawl teeth 1060 engaging the circular gear on the control member 1026, the drive direction of the tool would be clockwise. That is, when the handle is turned manually in a clockwise direction, it will drive the control member 1026 in that direction, which will cause the jaws 1030 to turn in that direction. When the handle is turned counterclockwise, the teeth 1060 of the pawl will ride over the teeth of the circular gear 1051 on the periphery of the control member 1050. When the position of the pawl 1050 is reversed, counterclockwise rotation of the handle 1022 will serve as the driving direction for the tool when operated manually.

The reversing pawl assembly 1032 is mounted in a well in the housing 1024 and is retained in the well by the retaining ring 1068. The axis of rotation of the reversing pawl assembly 1032 intersects the longitudinal center line of the tool as shown in FIG. 18.

The assembly of components within the handle 1022 are well-known in the art and the details thereof are not part of this invention. Rather, the manner in which they cooperate to drive the head 1020 of the tool is applicants' invention. Briefly, the rechargeable battery 1036 disposed in handle 1022 is connected through the button actuated switch assembly 1038 to motor 1040. The motor is turned on and off by the control button 1082. Motor 1040 in turn is directly connected to the planetary gear

reduction system 1042. The output shaft 1094 of the gear reduction system rotates an eccentric pin 1090 of the gear and shaft assembly 1044.

As is shown in FIGS. 14-16, the eccentric pin and gear shaft assembly 1044 includes the eccentric pin 1090 extending axially in the direction of the head 1024 of the tool on the periphery of disk 1092 mounted on the output shaft 1094 of the gear reduction system. The eccentric pin 1090 moves in a circular path and drives the control member 1026 through the mechanical assembly described below.

In FIG. 20, a cradle 1100 is shown to extend from the pin and gear shaft assembly 1044 at its right end into the head 1020 of the tool with an arcuate section 1102 surrounding the control member 1026. The portion 1102 which surrounds the control member 1026 does not engage the circular gear 1051 carried on control member 1026 but rather freely pivots about the axis 1104 of the head relative to that member.

The handle end 1106 of cradle 1100 carries a slide 1108 (see FIGS. 15 and 16) within which the pin 1090 moves to cause the cradle to rock back and forth about the axis 1104 of the head. Circular motion of the pin causes the slide to oscillate back and forth as suggested by the broken lines and arrows in FIG. 16. A pair of force release springs 1110 are disposed in the slide 1108 on each side of pin 1090 to prevent the pin 1090 from binding on the margins of the slide should the tool be shut off

with the pin in a neutral position in the slide. The springs provide some play between the pin 1090 and the slide side walls 1091 so as to enable the pin to move from a neutral position and thereafter impart motion to the slide and thereby to the cradle.

Motion of the cradle is converted to rotational motion of the control member 1026 by virtue of the operative connection of the two by means of the driving pawl 1120. The driving pawl and its relation to the cradle 1100 is clearly shown in FIGS. 14 and 20. In FIG. 14, the cradle 1100 is shown to include a tray portion 1122 on the handle side of the control member 1026. A post 1124 extends upwardly from the bottom wall 1126 of the tray portion, and the post carries a bushing 1128 which in turn supports the driving pawl 1120 for pivotal motion thereon. Driving pawl 1120 has separate teeth 1130 and 1132 at each end of the pawl side 1133 facing the control member 1026. The teeth 1130 and 1132 are similar to the teeth 1058 and 1060 on reversing pawl 1050, and the teeth 1130 and 1132 are positioned so as to selectively engage the teeth on the circular gear 1051 on the periphery of the control member 1026. In FIG. 20, the driving pawl 1120 is shown in a neutral position where neither of the gears 1130 and 1132 engages the control member but in operation, one or the other of the teeth engages the circular gear 1051.

The driving pawl 1120 is generally triangular in shape, and as stated, it is pivotally supported

on the post 1124 fixed to the bottom wall 1126 of the cradle. The corner 1134 of the cradle is connected to a coil spring 1136 by means of pin 1138, and the spring in turn is captured within spring housing 1140 that is pivotally supported by means of its post 1142 in the bottom wall 1126 of the cradle. The spring housing 1140 is also supported for pivotal motion by an upstanding post 1144 disposed in a recess 1146 on the lower surface of the cover 1148 of the tray portion of the cradle 1100.

As shown in FIGS. 14 and 19, the driving pawl 1120 carries a curved rib 1150 on its upper surface that extends into a curved channel 1152 in the bottom surface of reversing pawl 1050. The curved rib 1150 and its cooperating channel 1152 enables the reversing pawl 1050 to control the position of the driving pawl 1120. That is, when the reversing pawl 1050 is pivoted by means of its control lever 1052 so as to cause its teeth 1058 to engage the circular gear 1051 on the control member 1026, the tooth 1132 on the driving pawl 1120 will also engage the circular gear on the control member. When the position of the reversing pawl is changed so that its teeth 1060 engage the gear of control member 1026, the position of the driving pawl is similarly changed so as to cause its tooth 1130 to engage the circular gear 1027 of the control member.

In FIGS. 21 to 24, the manner in which the driving pawl 1120 and reversing pawl 1050 cooperate

with one another in both the manual and automatic or power phases of the operation is suggested. In FIG. 21, the eccentric pin 1090 is shown to be vertically aligned with the longitudinal axis of the tool in what may be termed a neutral position and the teeth 1058 of the reversing pawl 1050 and the tooth 132 of the drive pawl 1120 are positioned to operatively engage the control member 1026 and more particularly the circular gear 1051 on its periphery. Positioning the reversing pawl 1050 in the position shown in FIG. 21 automatically causes the driving pawl 1120 to assume the position illustrated also. As the eccentric pin 1090 moves away from the longitudinal center line of the tool as shown in sequence in FIGS. 22, 23, and 24, through its engagement with the slide 1108 in the cradle, the cradle pivots counterclockwise about head axis 1104 and carries the driving pawl 1120 with it. By virtue of the engagement of tooth 1132 of the driving pawl with the circular gear 1051 on the control member 1026, the control member turns counterclockwise as suggested by arrow 1160 and turns the jaws of the tool with it. As the cradle 1100 and driving pawl 1120 cause the control member 1026 to move in that direction, the reversing pawl 1050 and more particularly its teeth 1058 skip over the teeth initially engaged and move to the next adjacent teeth without interfering with the rotation of the control member 1026.

In FIG. 24, the eccentric pin 1090 is shown to

have moved through 90° causing maximum pivoting action of the cradle in a counterclockwise direction about the head axis 1104. In that figure it will be noted that the teeth 1058 of the reversing pawl have moved to the next teeth on the circular gear on control member 1026. During the next 180° of rotation of the eccentric pin 1090, the cradle will move from the position shown in FIG. 24 to an opposite position, that is, the other extreme position of cradle 1100. As that occurs, the tooth 1132 will ride over the engaged tooth of the circular gear and engage the next tooth of the circular gear. Simultaneously, the reversing pawl 1050 will prevent the control member 1026 from being dragged by the drive pawl in that direction. As the eccentric pin 1090 moves the last 90° of its course to return to the position shown in FIG. 21, the driving pawl 1120 with its tooth 1132 engaging the circular gear 1051 will once again cause the rotation of the control member in the direction of arrow 1160.

To reverse direction of rotation of the control member 1026, the operator need only reverse the position of the reversing pawl assembly 1032 so as to cause the teeth 1060 to engage the circular gear 1051. That in turn will cause the tooth 1130 of the driving pawl 1120 also to engage the circular gear, and the oscillating motion of the cradle in response to rotation of the eccentric pin 1090 will cause the control member to rotate in a clockwise direction.

From the foregoing description, it will be appreciated that spring 1136 allows the driving pawl 1120 to ride over the teeth on the circular gear of the control member during that portion of the cycle in which the driving pawl steps back over the teeth to engage the next tooth of the circular gear 1051 so as to enable it to again advance it under the influence of the motor. When the driving pawl 1120 is reversed by means of the change in position of reversing pawl 1050, the spring housing 1140 pivots on its posts 1142 and 1144 to the position opposite that depicted in FIG. 21.

As stated above, the reversing pawl 1050 is pivotally supported along the longitudinal center line of the tool. However, the driving pawl 1120 is shown positioned offset from longitudinal center line of the tool by approximately 4°. In the embodiment shown, there are 45 teeth on the circular gear carried by the control member 1026, and therefore each tooth represents 8° of rotational motion of the control member when it is advanced by the driving pawl 1120. Because the driving pawl is circumferentially displaced 4° from the reversing pawl 1050, the pivotal motion of the two pawls as they slide over the teeth from one cycle to the next will be out of phase with one another.

The tool shown in FIGS. 12 to 24 may be powered either manually or electrically. However, the electrical or automatic drive phase of the tool is principally used to rapidly run the workpiece such

as a bolt from one end of a screw to a point where it encounters major resistance to rotation, or alternatively, to unscrew the bolt from the screw after initially overcoming the major resistance to rotation. The tool typically is used as follows: with the motor turned off, the user sets the reversing pawl and then tightens the jaws on the workpiece by rotating the adjusting disk 1028. When this is done, the operator depresses the power button 1082 which causes the power handle to turn the eccentric pin 1090 and through cradle 1100 and pawl 1120 rotates the control member 1026 so as to cause the workpiece engaged by the jaws to rotate until substantial resistance is encountered. When that occurs, the user releases the power button 1082 and continues rotation of the control member 1026 by rotating the handle about the head axis. In this fashion, the workpiece may be tightened to the degree desired. Because, this power driven tool includes the jaw locking system 1034 shown in the embodiment of FIGS. 1-7, the jaws will not open in response to the reactive force applied to them by the workpiece as torque is applied by the tool to it.

While in the foregoing description, the power handle described is driven by a rechargeable battery, it should be understand that in addition to the rechargeable battery the handle housing may also contain a low voltage DC power supply and charging circuit along with a plug receptacle for receiving

the plug of an electrical cord. With such an arrangement, the tool may be used either as a cordless power tool when the rechargeable battery is fully charged or it may be driven by primary electric power through the electrical cord. Similarly, the power handle may be pneumatically driven by conventional power handle arrangements that are well-known. In either of these modifications, the eccentric pin is driven by the power supply and connected to the head through the rocking cradle in the manner shown.

Having described and illustrated this invention in detail, those skilled in the art upon reading the description will recognize that numerous modifications may be made in the several embodiments without departing from the spirit of this invention. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments illustrated and described. Rather, its scope is to be determined by the appended claims and their equivalents.

be turned by the head,

a control member on the housing and engaging the jaws and limiting the motion of the jaws to radial motion with respect to the control member,

an adjusting disk surrounding at least a portion of the control member and having inwardly directed cams engaging the jaws for driving the jaws radially inwardly in response to rotation of the disk in one rotational direction with respect to the control member,

means interconnecting the adjusting disk and jaws for moving the jaws radially outward in response to rotation of the disk in an opposite rotational direction with respect to the control member,

and releasable locking means operatively interconnecting the control member and the adjusting disk for preventing rotation of the disk in said opposite rotational direction so as to prevent the jaws from opposing in response to reactive forces applied to the jaws by a workpiece.

2. A wrench head as defined in claim 1 wherein said control member supports said adjusting disk on said housing.

3. A wrench head as defined in claim 1 wherein said control member supports said jaws on said housing.

2. A wrench head as defined in claim 1 wherein said control member supports said adjusting disk on said housing.

3. A wrench head as defined in claim 1 wherein said control member supports said jaws on said housing.

4. A wrench head as defined in claim 2 wherein said control member supports said jaws on said housing.

5. A wrench head as defined in claim 1 wherein the adjusting disk and control means are movable axially with respect to one another.

6. A wrench head as defined in claim 5 wherein relative axial movement of the adjusting disk controls the condition of the locking means.

7. A wrench head as defined in claim 6 wherein the adjusting disk is biased axially in one direction to activate the locking means, and motion of the disk in the opposite axial direction against the bias releases the locking means.

8. A wrench head as defined in claim 1 wherein the control member has a flange which radially overlaps an end of the adjusting disk near the jaws.

locking means and separate from one another to release the locking means.

11. A wrench head as defined in claim 10 wherein

the disk is moved axially with respect to the control member to separate the teeth so as to release the locking means.

12. A wrench head as defined in claim 10 wherein

a dust cover encloses the teeth on the faces.

13. A wrench head as defined in claim 7 wherein the control member is biased to move away from the adjusting disk.

14. A wrench head as defined in claim 11 wherein spring means operatively engage the disk to bias the teeth to an engaged position.

15. A wrench head as defined in claim 14 wherein the control member is biased to move away from the adjusting disk.

16. A wrench head as defined in claim 7 wherein

a cam means is operatively connected to the adjusting disk for moving the disk axially when the cam means is moved circumferentially with respect to the axis.

15. A wrench head as defined in claim 14 wherein the control member is biased to move away from the adjusting disk.

16. A wrench head as defined in claim 7 wherein a cam means is operatively connected to the adjusting disk for moving the disk axially when the cam means is moved circumferentially with respect to the axis.

17. A wrench head as defined in claim 16 wherein said cam means includes a rotatably mounted ring disposed between the control member and disk.

18. A wrench head as defined in claim 10 wherein the teeth on the disk are movable axially with respect to the disk toward and away from the teeth on the flange.

19. A wrench head as defined in claim 1 wherein the housing and control member have openings therethrough coaxial with the axis of the housing for enabling a member onto which the workpiece is to be turned to extend through the head.

20. A wrench head as defined in claim 1 wherein a handle is connected to and fixed with respect

22. A wrench head as defined in claim 21 wherein

the ratchet interconnects the housing and the control member.

28. A wrench head as defined in claim 22 wherein the ratchet has two positions, one of said positions connecting the housing and control member so that clockwise rotation of the handle will rotate the jaws in the same direction and the other of the positions joining the housing and control member so that conterclockwise rotation of the handle will rotate the jaws in the counterclockwise direction.

24. A wrench head as defined in claim 21 wherein

the handle contains a motor, and drive means are provided for selectively connecting the motor to the control member for utilizing the motor to rotate the jaws.

25. A wrench head as defined in claim 24 wherein

the drive means comprises a driving pawl mounted in the handle for engaging the control member to move the member stepwise as the motor rotates.

26. A wrench head as defined in claim 25 wherein

wherein

the drive means comprises a driving pawl mounted in the handle for engaging the control member to move the member stepwise as the motor rotates.

26. A wrench head as defined in claim 25 wherein

the direction of operation of the driving pawl is controlled by the ratchet.

27. A wrench head as defined in claim 25 wherein

both the ratchet and the driving pawl each have two operative positions whereby both the handle and motor can drive the control member either clockwise or counterclockwise.

28. A power driven adjustable ratchet wrench comprising

a housing,

at least two jaws mounted on the housing,

a control member engaging the jaws and rotatable about its axis to turn a workpiece engaged by the jaws,

a circular gear on the control member, a cradle mounted on the housing for oscillating motion adjacent the control member,

a driving pawl carried by the cradle and engaging the circular gear for stepwise rotation of

the motor to oscillate the cradle.

30. A power driven adjustable ratchet wrench as defined in claim 28 wherein

a handle is fixed to the housing for manually rotating the control member to turn the jaws.

31. A power driven adjustable ratchet wrench as defined in claim 30 wherein

a reversing pawl operatively connects the control member to the handle, said reversing pawl being pivotally mounted on the housing and having alternate teeth for engaging the circular gear so that the handle can selectively drive the control member in opposition direction.

32. A power driven adjustable ratchet wrench as defined in claim 31 wherein

the driving pawl is pivotally mounted for engaging the circular gear in different positions so as to selectively rotate the control member in opposite directions in response to the oscillation of the cradle.

33. A power driven adjustable ratchet wrench as defined in claim 32 wherein

the position of the drive pawl is controlled by the position of the reversing pawl.

34. A power driven adjustable ratchet wrench as defined in claim 28 wherein

the cradle surrounds and oscillates about the axis of the control member.

35. A power driven adjustable ratchet wrench as defined in claim 34 wherein

a handle is fixed to the housing for manually rotating the control member to turn the jaws,

and a reversing pawl operatively connects the handle to the control member for setting the direction of rotation of the control member in response to rotation of the handle.

36. A power driven adjustable ratchet wrench as defined in claim 35 wherein

the driving pawl is pivotally mounted for engaging the circular gear in different positions so as to selectively rotate the control member in opposite directions in response to the oscillation of the cradle.

37. A power driven adjustable ratchet wrench as defined in claim 36 wherein

an adjusting disk is rotatably mounted on the housing and surrounds at least a portion of the jaws,

and cam surfaces on the disk engage the jaws for moving the jaws axially to loosen and tighten them on a workpiece.

38. A power driven adjustable ratchet wrench as defined in claim 37 wherein

a locking means interconnects the jaws and control member for preventing reactive forces applied to the jaws by a workpiece from opening the jaws.

Fig. 1

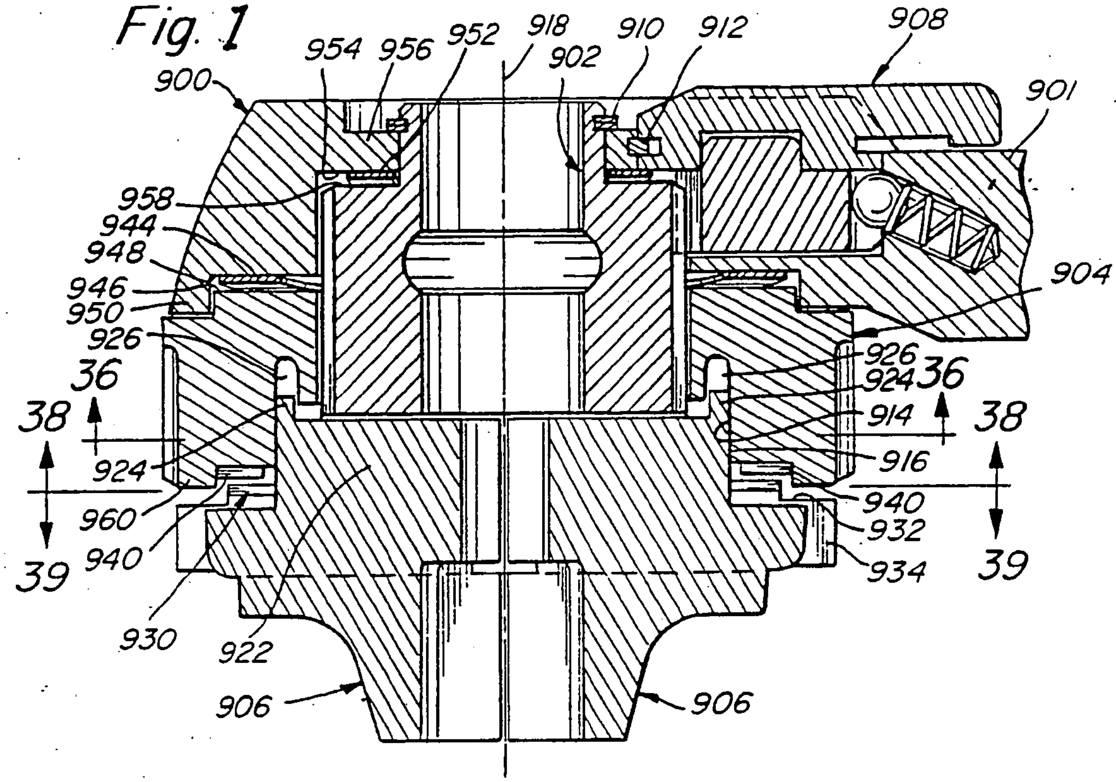
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Fig. 2

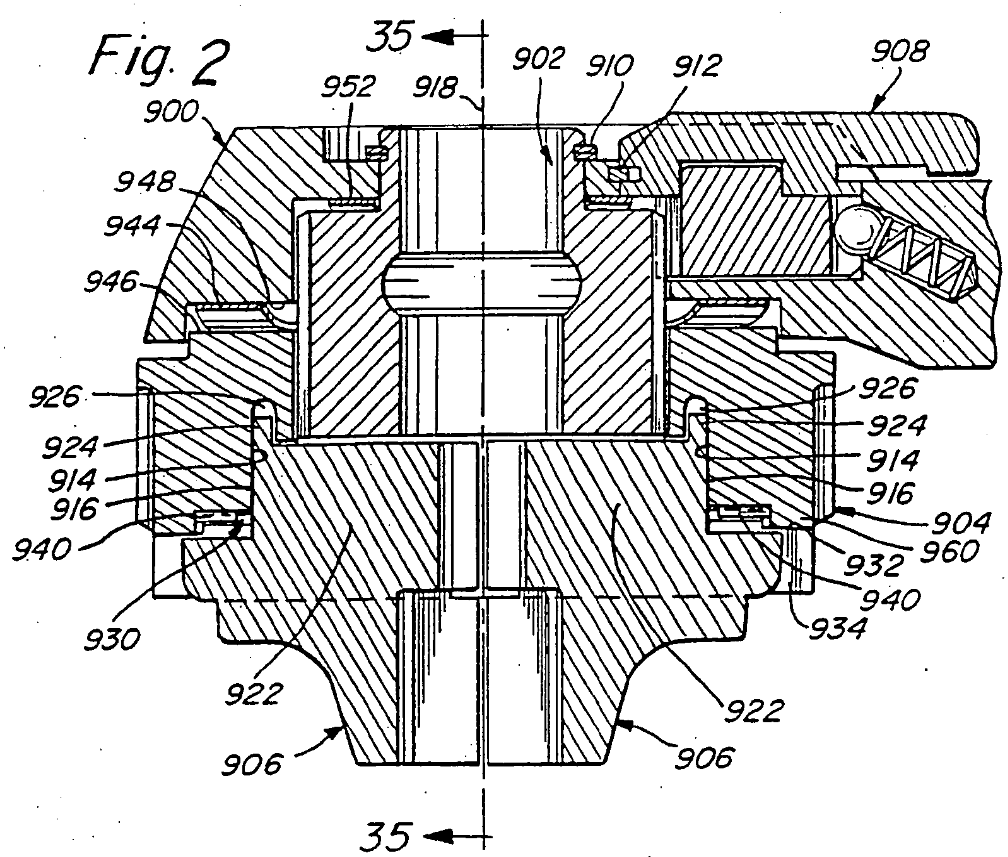
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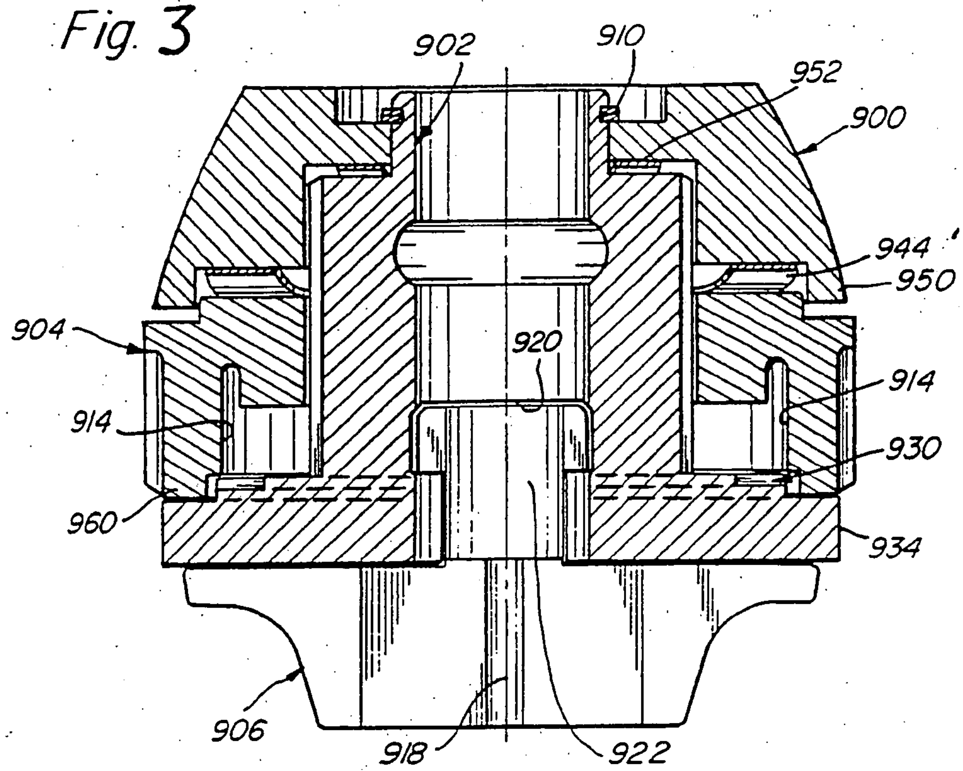
Fig. 3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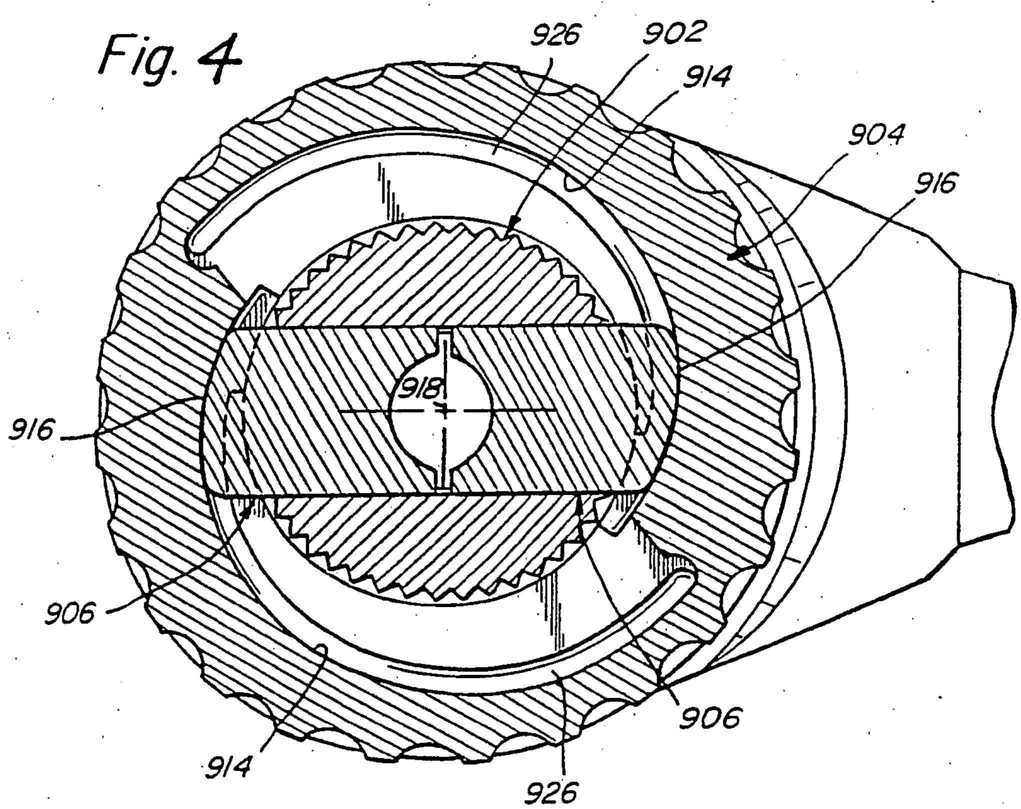
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Fig. 5

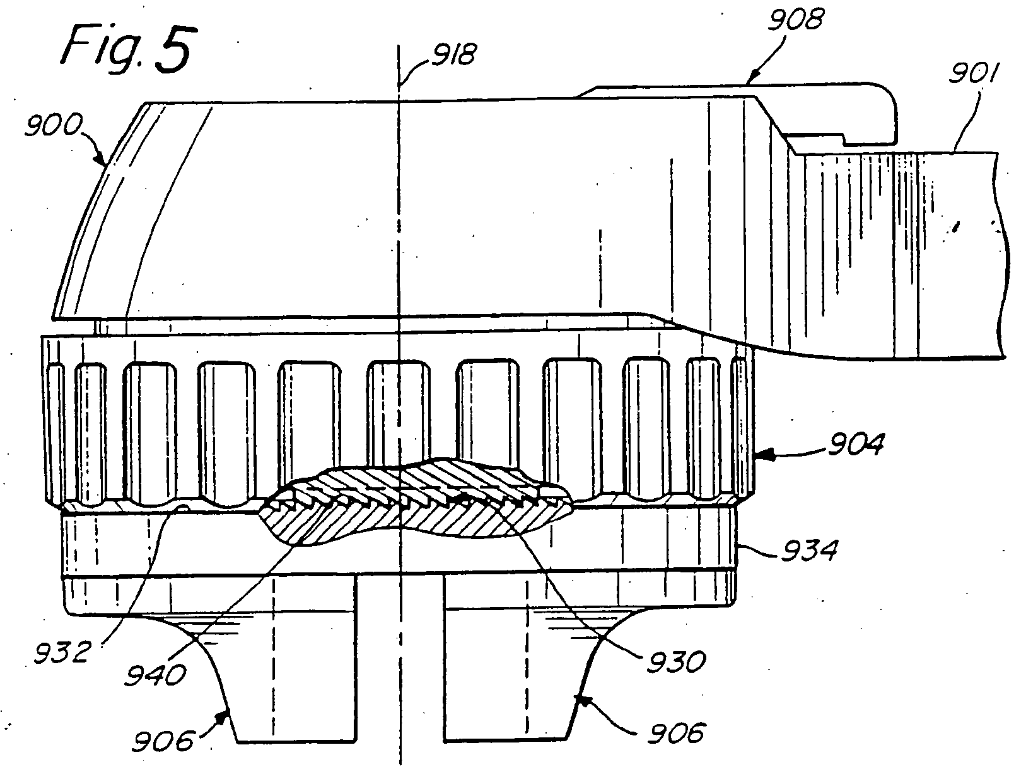
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Fig. 6

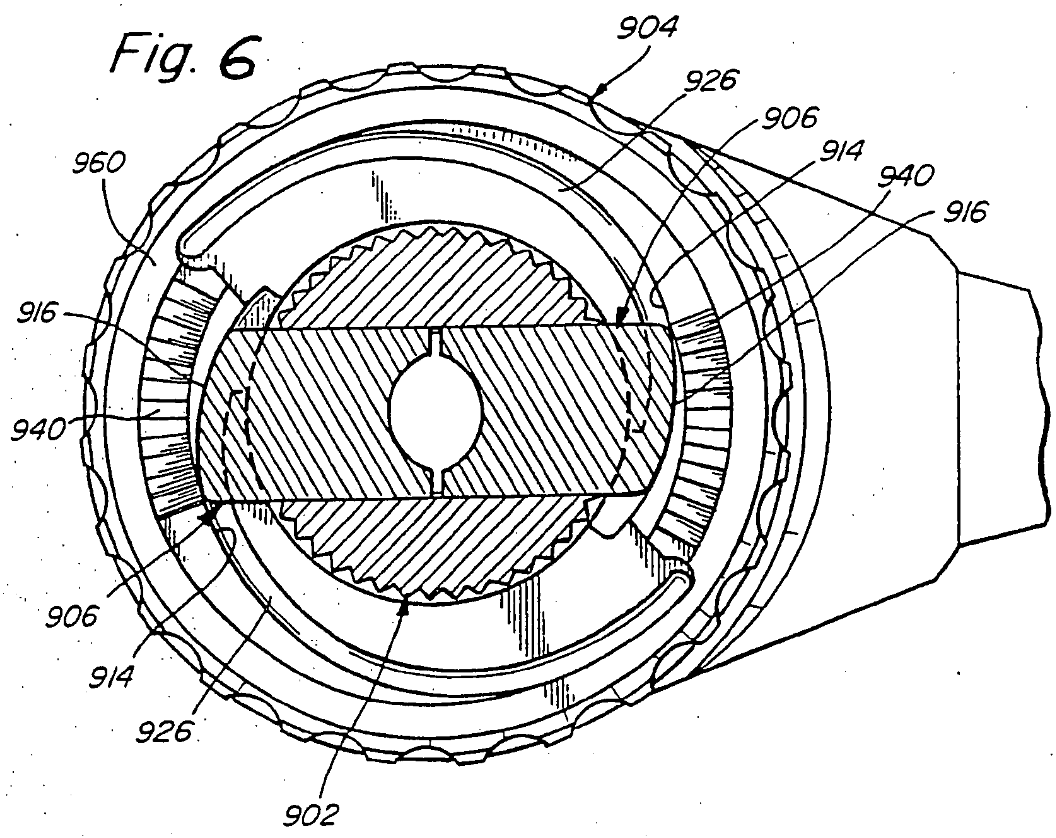
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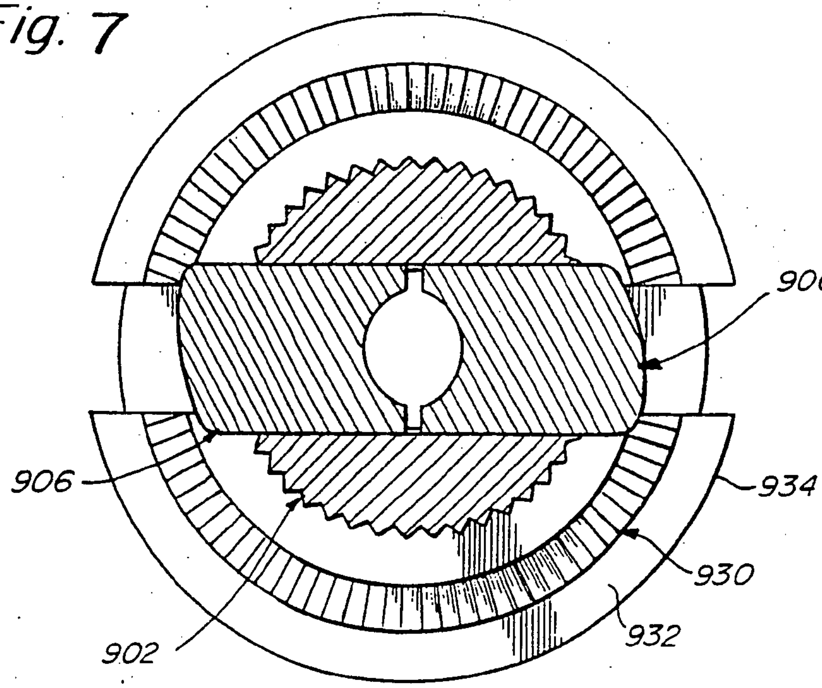
Fig. 7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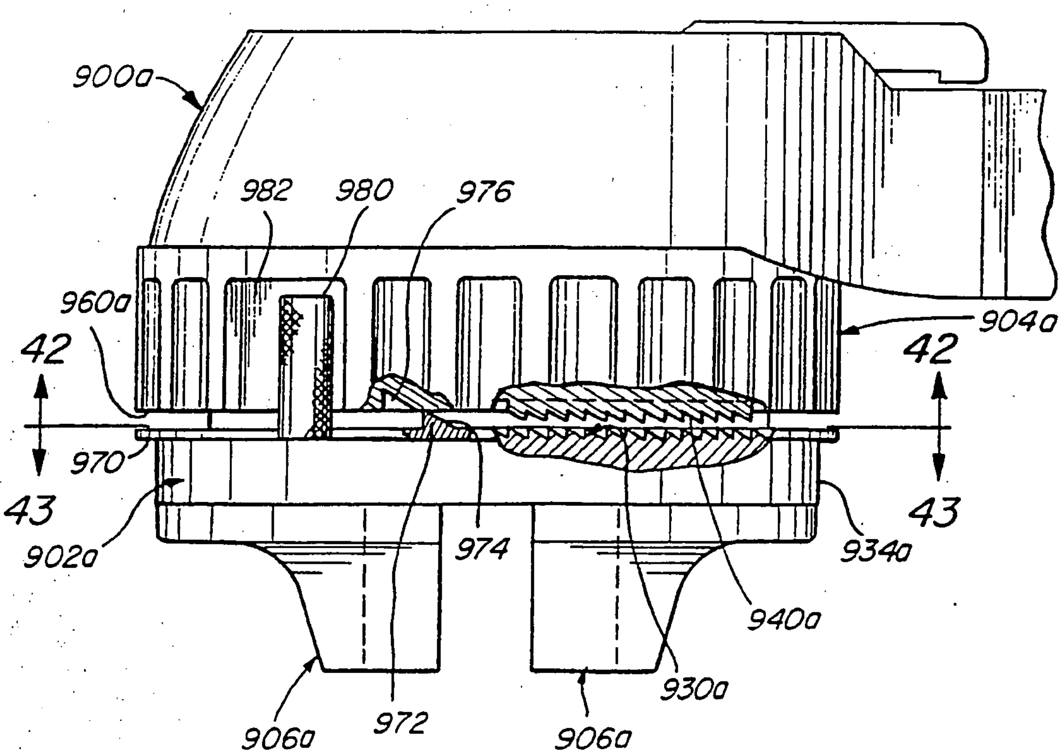
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Fig. 9

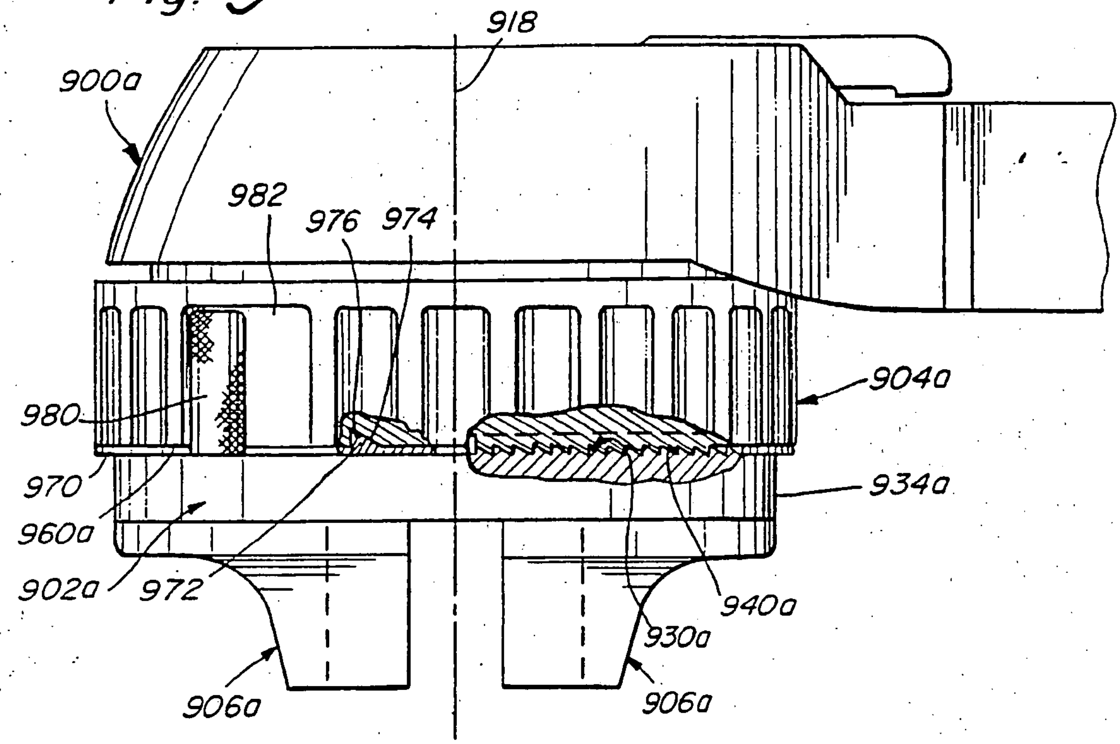
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Fig. 10

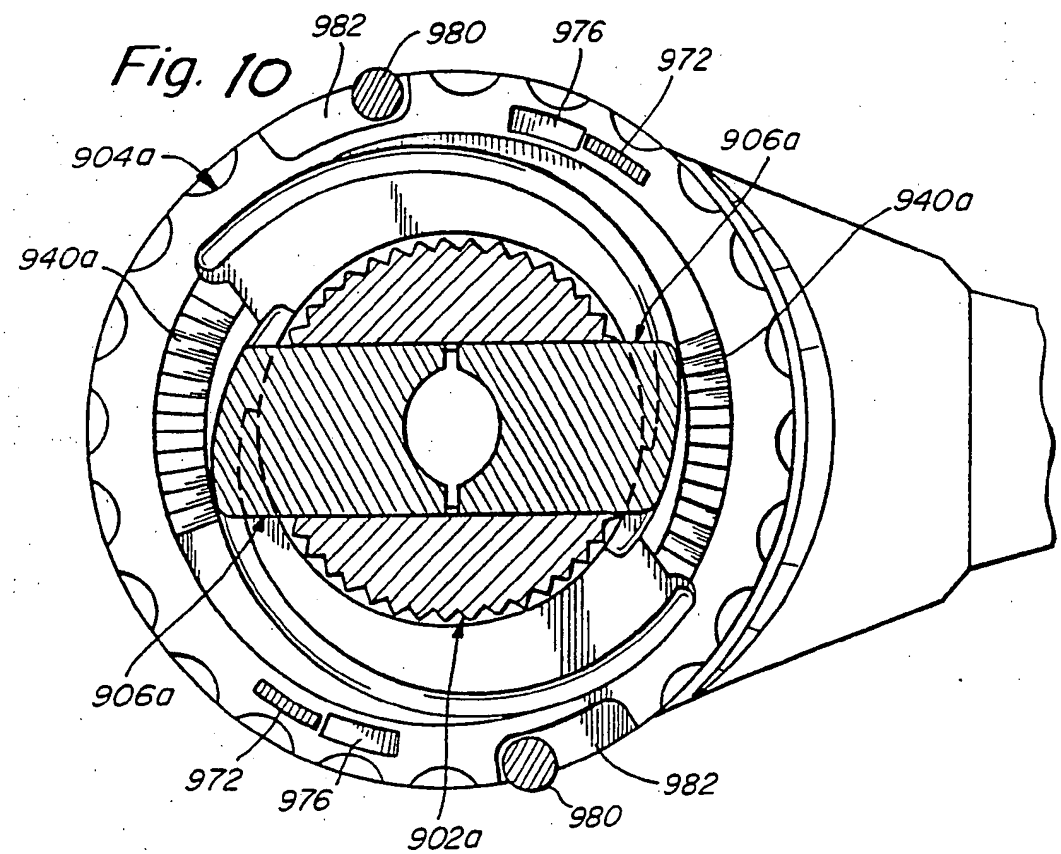
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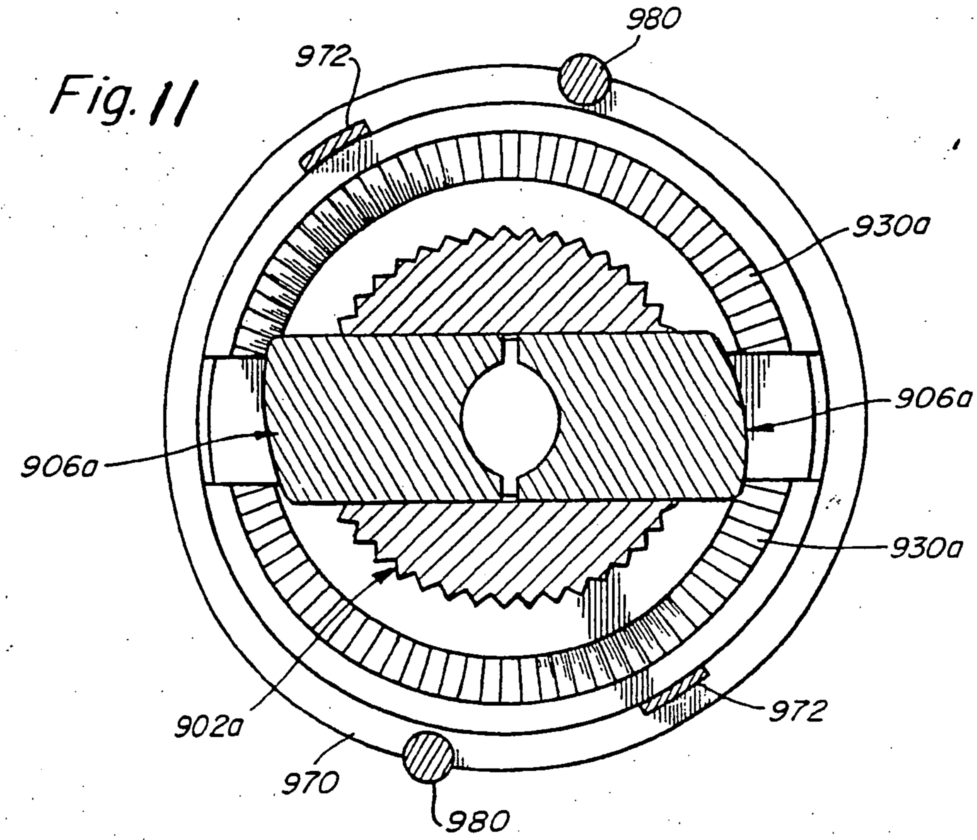
Fig. 11



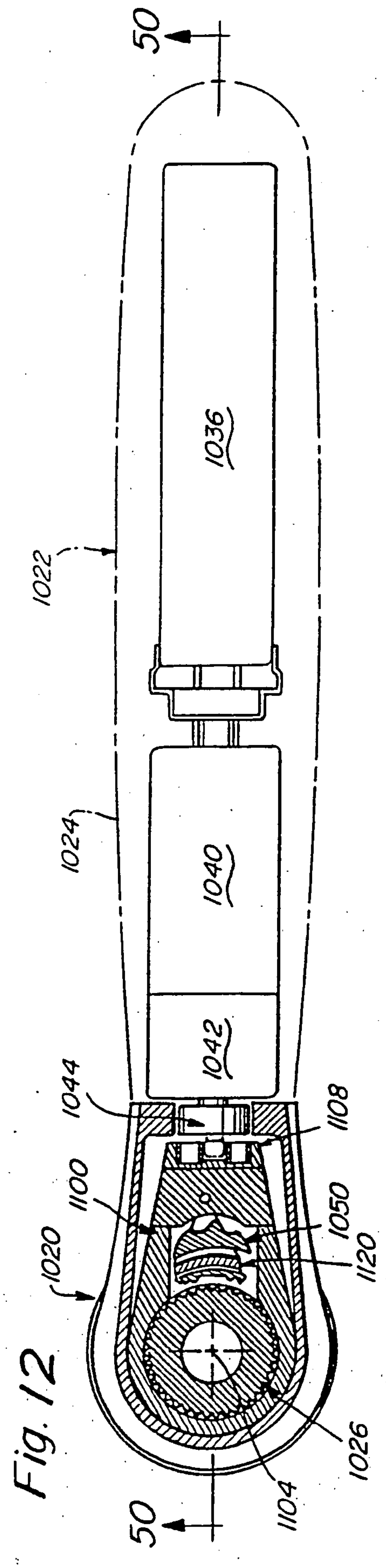

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Fig. 12

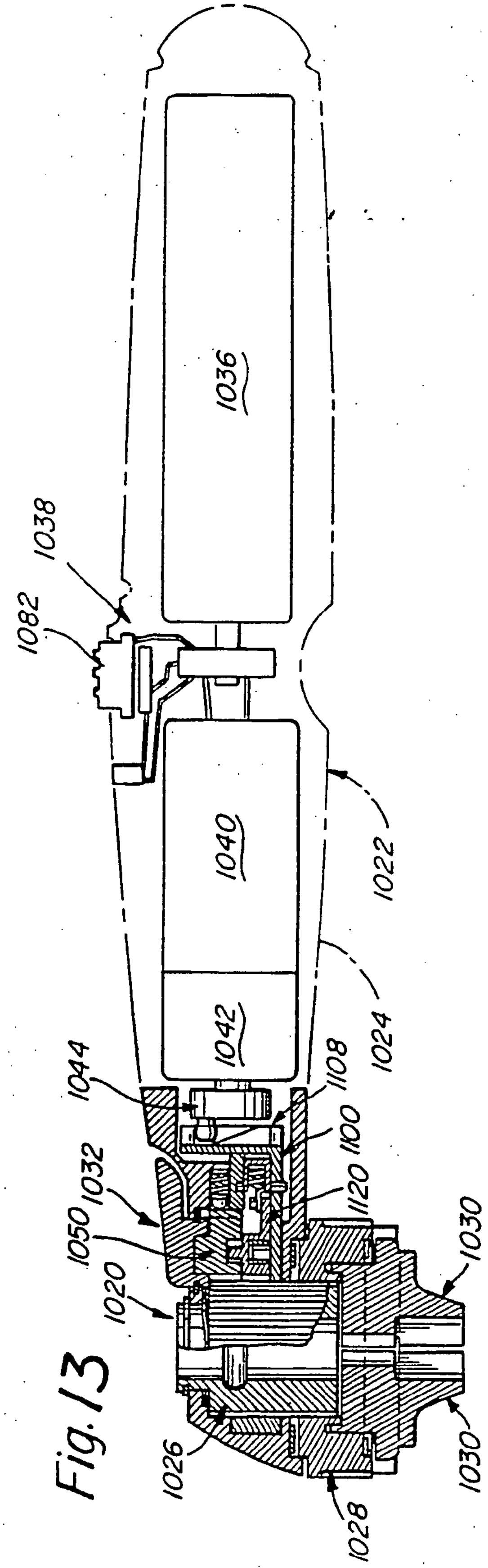
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Fig. 13

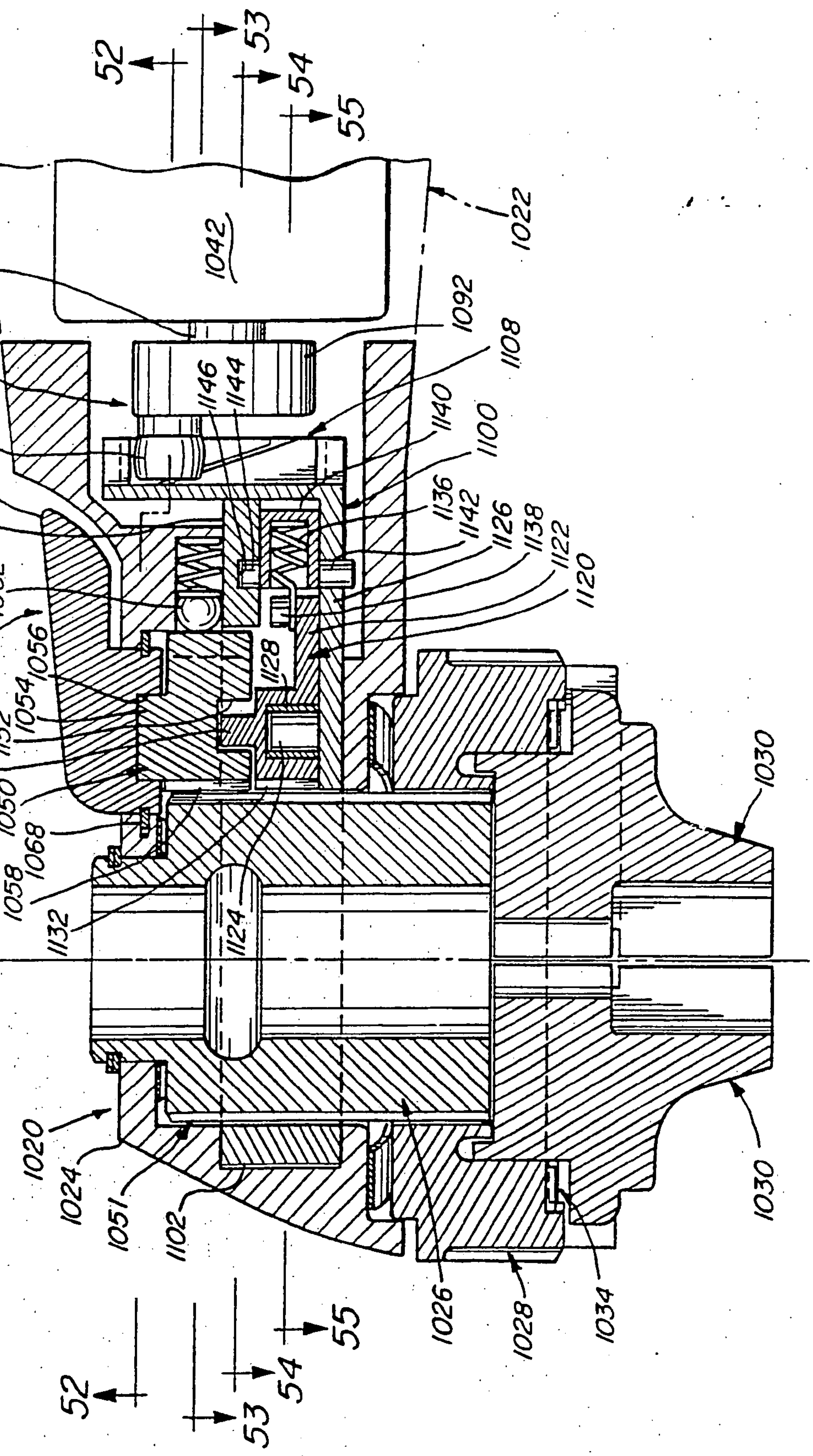
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Fig. 14

Fig. 15

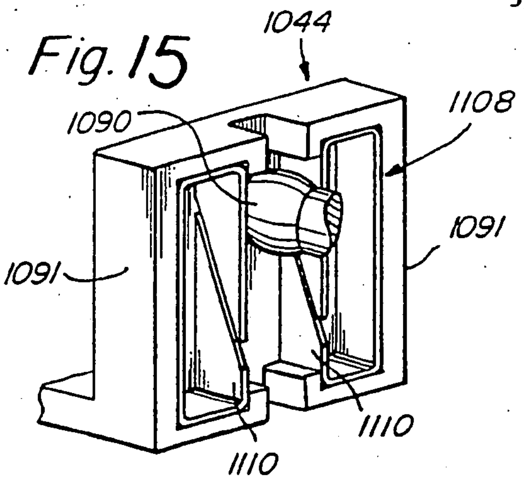
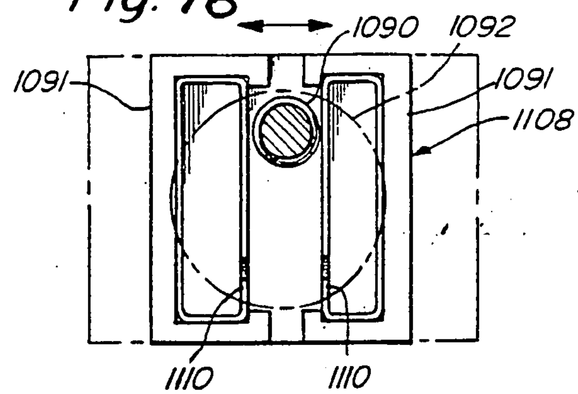


Fig. 16



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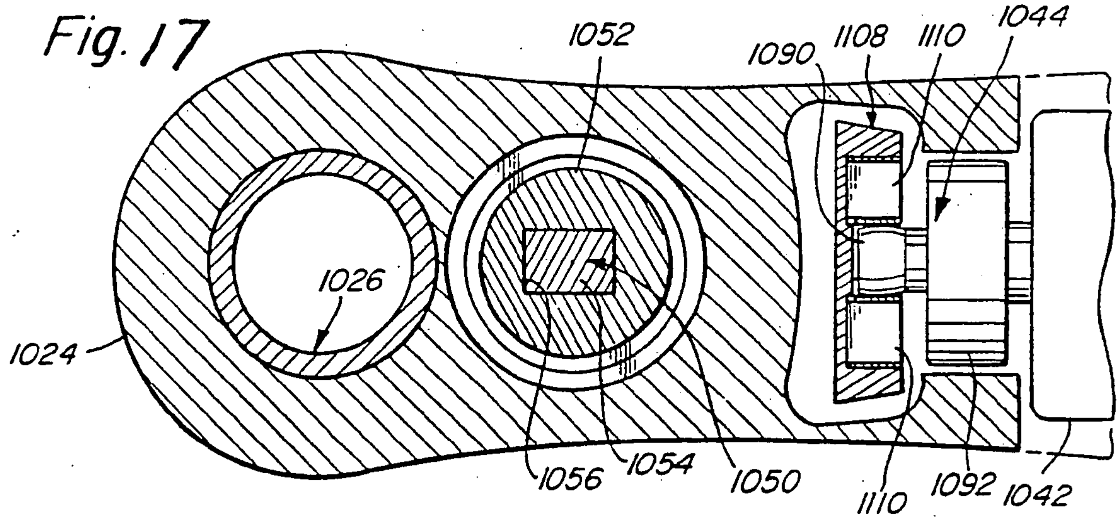

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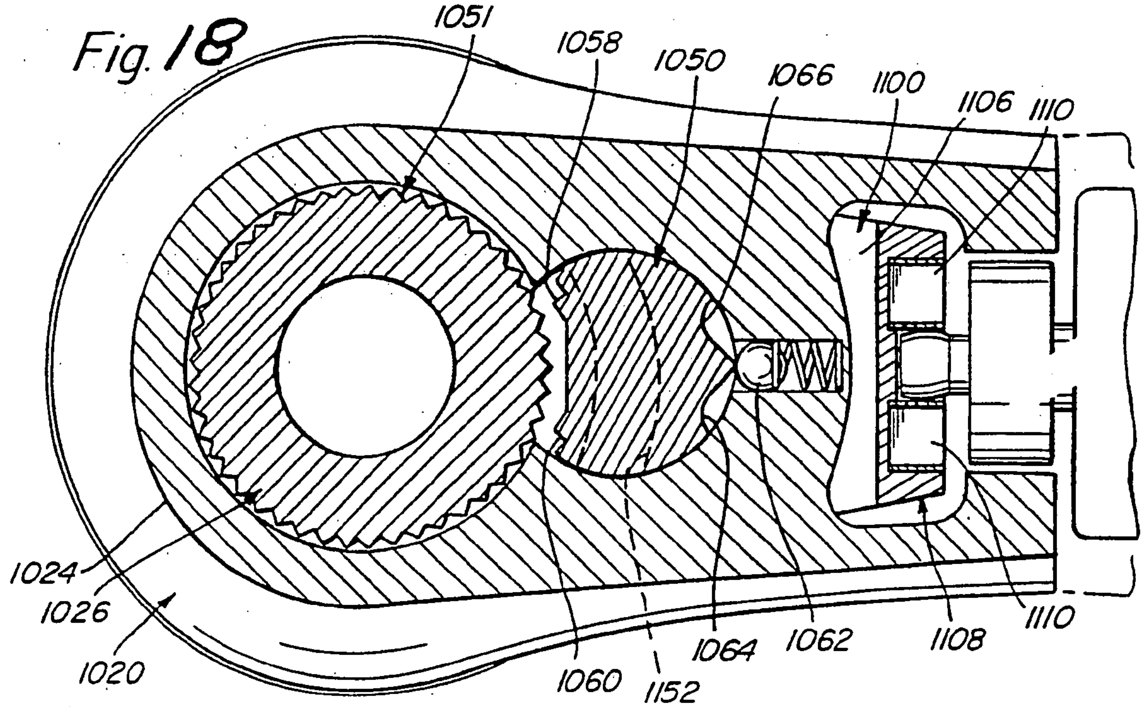

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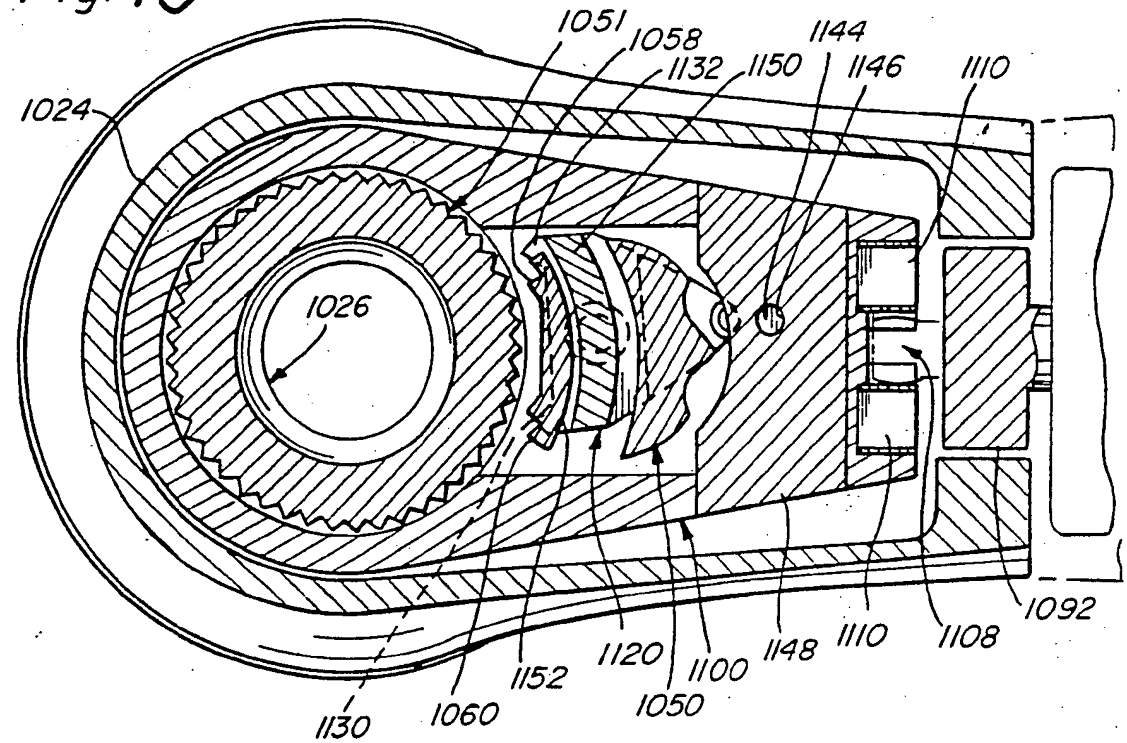
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Fig. 20

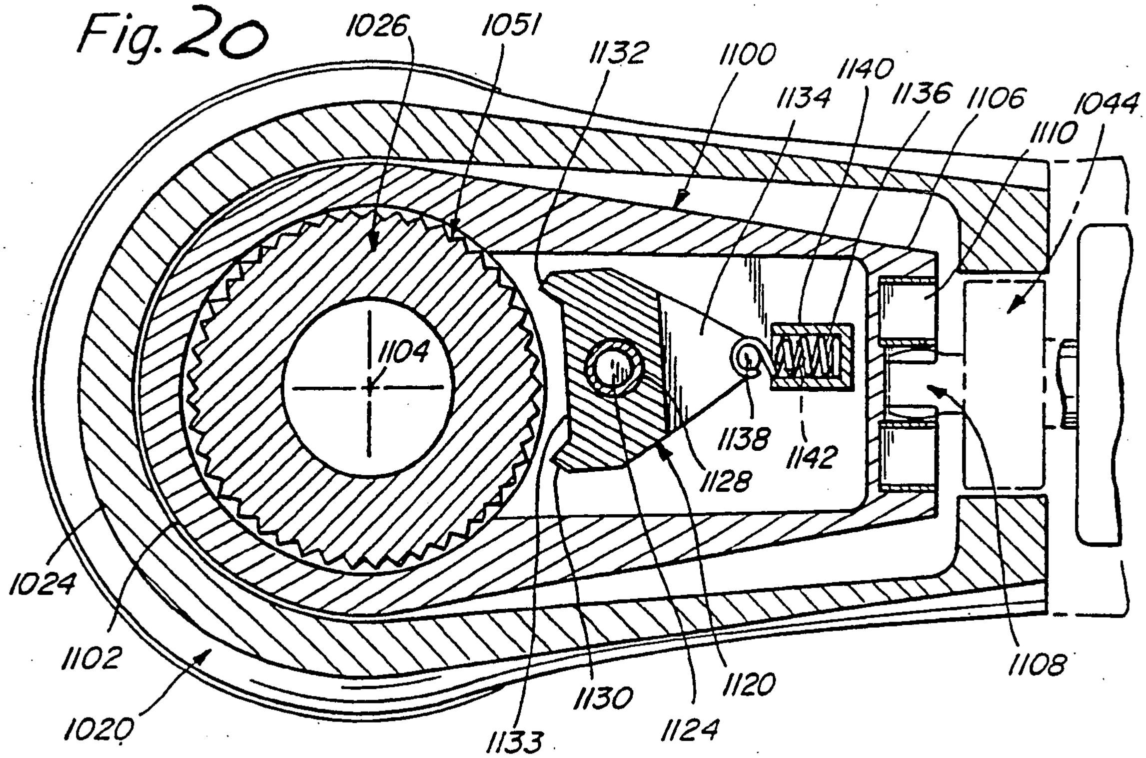
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Fig. 21

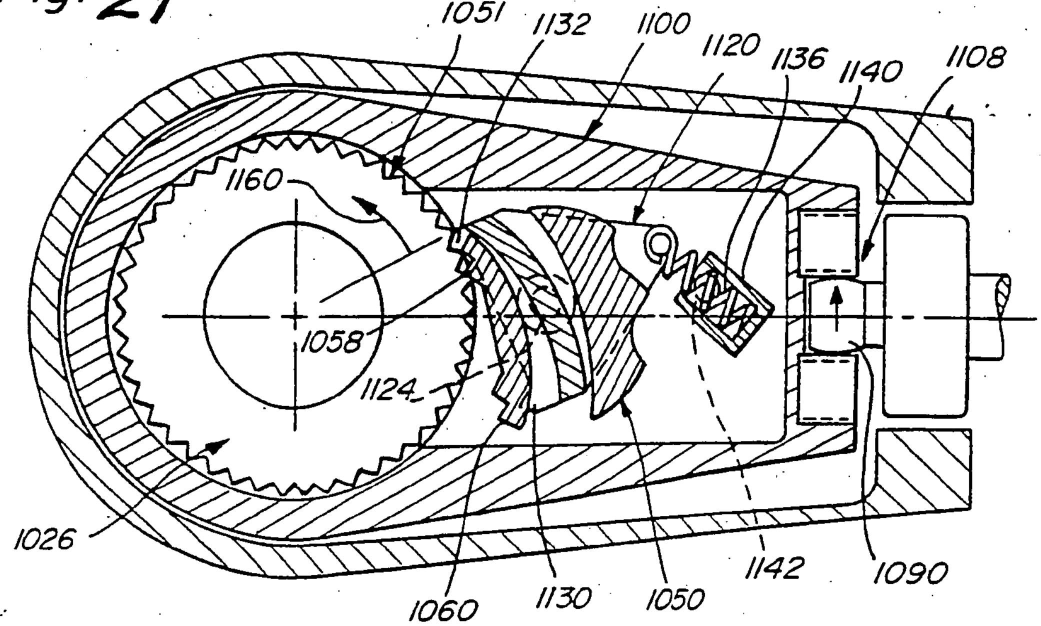
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Fig. 22

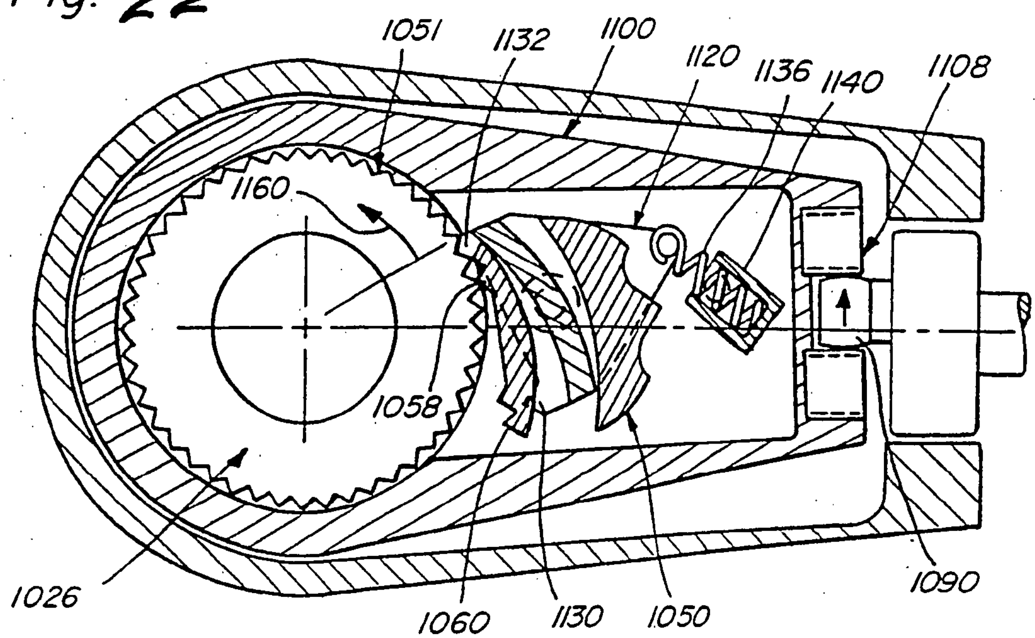
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Fig. 23

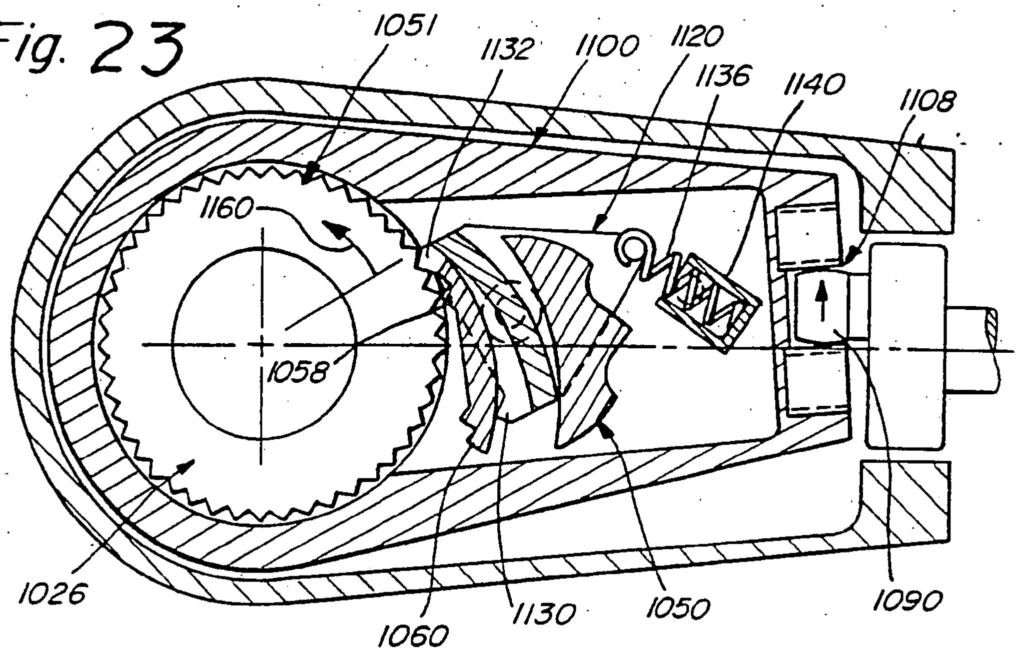
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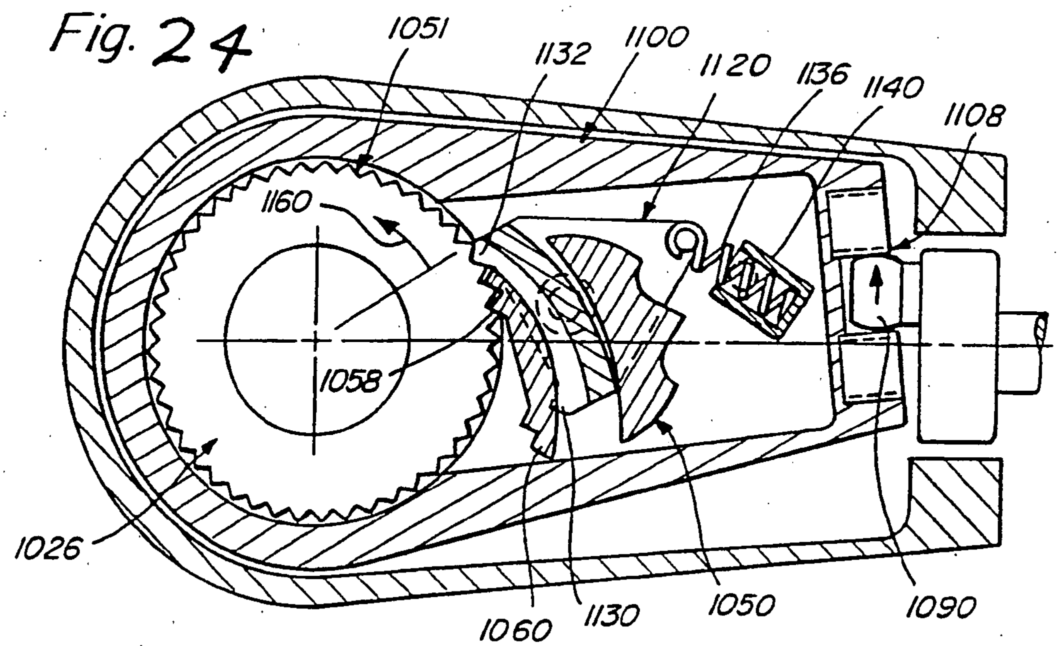
Fig. 24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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/03910

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B25B 13/46
US CL :81/63.2
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 81/63.2, 58.4, 128; 279/66, 110, 114

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 1,000,277 (McCoy) 8 August 1911	1-38
A	US, A, 1,274,337 (Schwartz) 30 July 1918	1-38
A	US, A, 1,450,641 (Ograbisz) 3 April 1923	1-38
A	US, A, 4,722,252 (Fulcher et. al.) 2 February 1988	1-38
&	US, A, 5,090,273 (Fossella) 25 February 1992	1-38
&,E	US, A, 5,207,129 (Fossella) 4 May 1993	1-38

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
28 May 1993	06 JUL 1993

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